Vehicle and Axle Load Scales

Commercial and Law Enforcement

Chapter 1

Commercial and Law Enforcement

- Commercial
  - buying or selling
  - service
    - transportation (freight, household moving).
    - storage, processing.
    - vehicle weighing service.
- Law enforcement
  - **vehicle weights (total and axle loads)**
  - **statistical purposes**

HB 44 – Definitions

- **<u>Vehicle Scale</u>: a scale adapted to weighing highway, farm, or other large industrial vehicles (except railroad freight cars), loaded or unloaded.**
- **<u>Axle-Load Scale</u>: a scale permanently installed in a fixed location, having a load-receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a highway vehicle.**

Purpose of Weights and Measures

- Equity in the marketplace
  - protect buyer and seller
- Ensure fair trade and protect competition.
- Fraud: intentional, apathy, accidental
  - regardless of its source both consumers and businesses suffer.

Information

- Value comparison.
- That weights are accurate within tolerances.
- Ensure the traceability of weights used for commercial and law enforcement purposes.

Cardinal Scale

Fairbanks Scale

Cardinal Scale

Fairbanks Scale


WEIGHING RATES
GROSS $3.00
TARE $3.00
3 AXLE WGT & GROSS $6.00
PAY HERE

Weigh-Tronix Scale

Types of Vehicle Scales

Fairbanks Scale

Rice Lake Weighing Systems

Fairbanks Scale

Fairbanks Scale

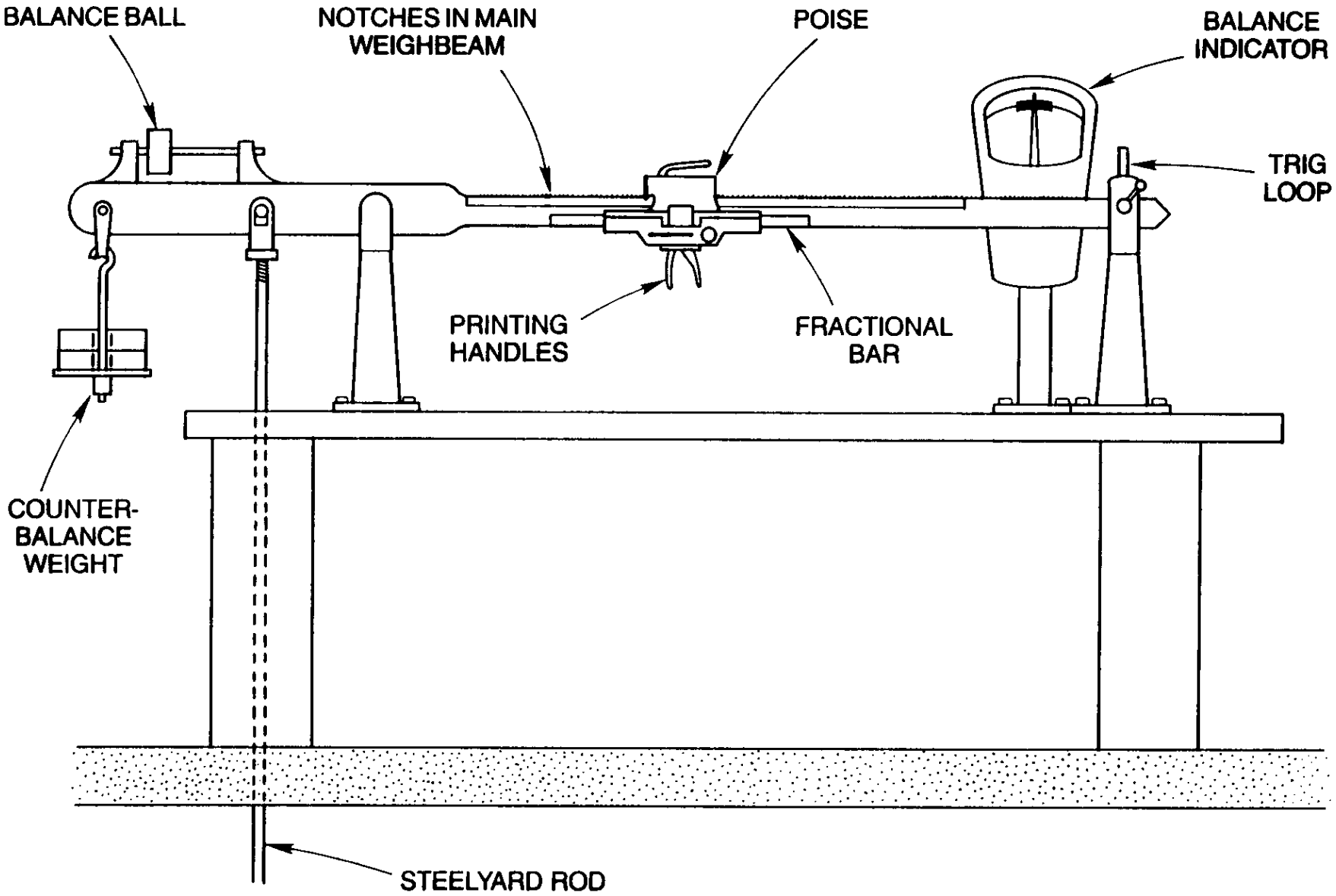

WEAVER BROS., INC.

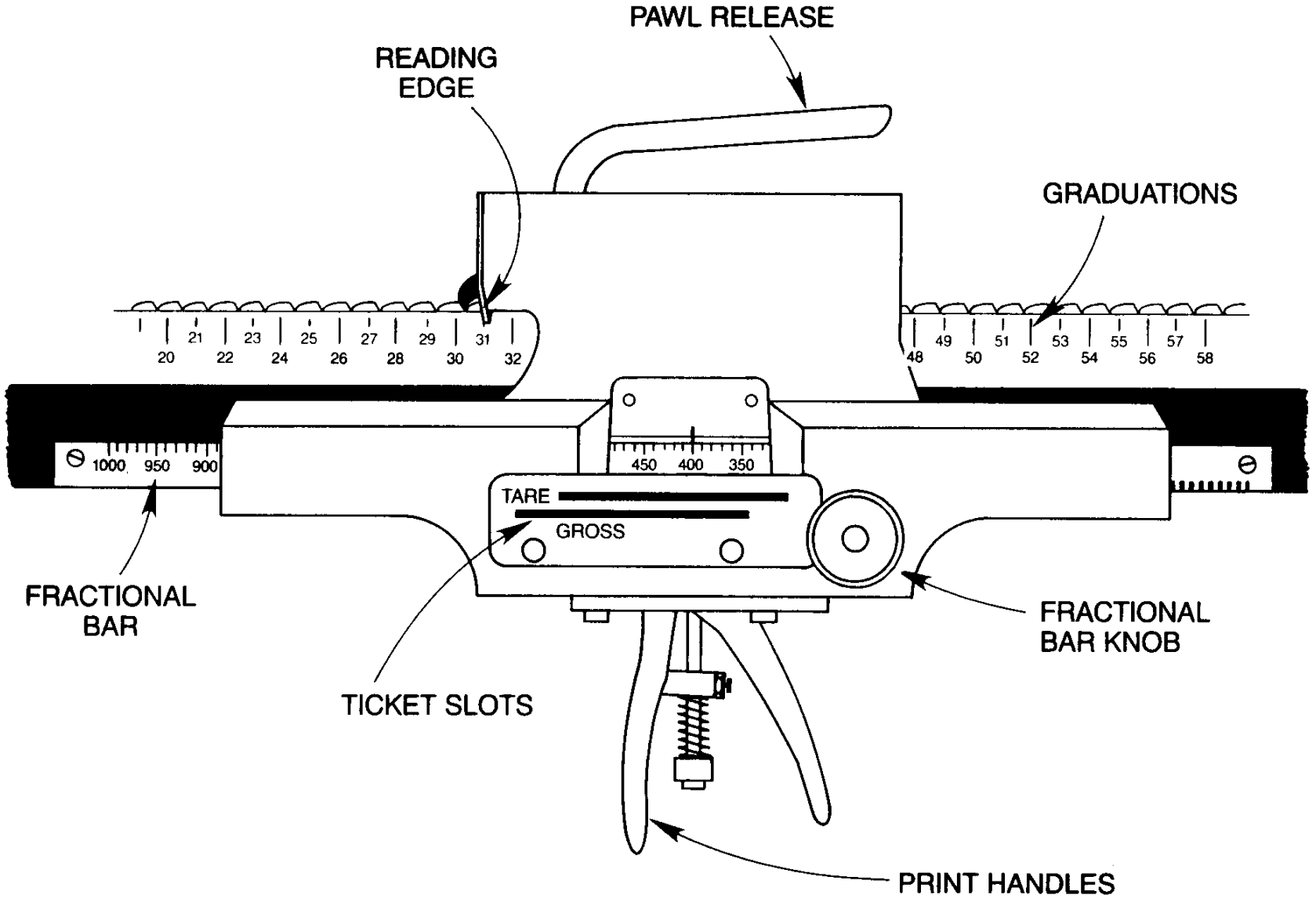
B-Tek Scale

B-Tek Scale

Vehicle Scale Components


SUNRISE MARINE
POLAR
TYPE REGISTERING BEAM
FAIRBANKS
FAIRBANKS


BALANCE BALL
NOTCHES IN MAIN WEIGHBEAM
POISE
BALANCE INDICATOR
TRIG LOOP
PRINTING HANDLES
FRACTIONAL BAR
COUNTER-BALANCE WEIGHT
STEELYARD ROD


PAWL RELEASE
READING EDGE
GRADUATIONS
20 21 22 23 24 25 26 27 28 29 30 31 32
48 49 50 51 52 53 54 55 56 57 58
1000 950 900
450 400 350
TARE
GROSS
FRACTIONAL BAR
TICKET SLOTS
FRACTIONAL BAR KNOB
PRINT HANDLES

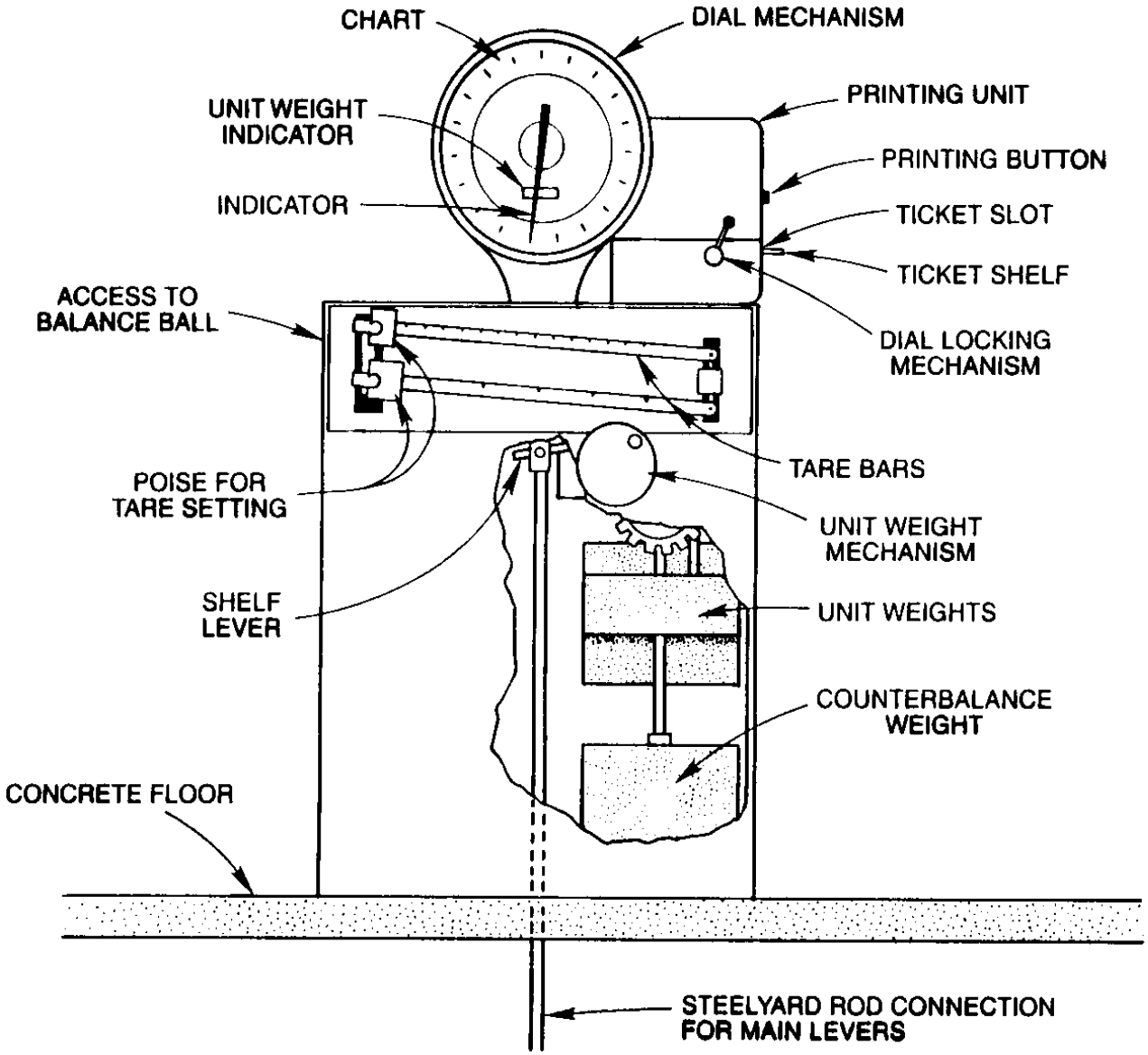


CHART
DIAL MECHANISM
UNIT WEIGHT INDICATOR
PRINTING UNIT
PRINTING BUTTON
INDICATOR
TICKET SLOT
TICKET SHELF
ACCESS TO BALANCE BALL
DIAL LOCKING MECHANISM
TARE BARS
POISE FOR TARE SETTING
UNIT WEIGHT MECHANISM
SHELF LEVER
UNIT WEIGHTS
COUNTERBALANCE WEIGHT
CONCRETE FLOOR
STEELYARD ROD CONNECTION FOR MAIN LEVERS


FAIRBANKS
NOMINAL CAPACITY 120,000 x 20 lb
CENTER OF ZERO
ZERO
lb
kg
GROSS
NET
7
8
9
4
5
6
AUTO TARE
PRINT
TARE RECALL
1
2
3
0
ENTER
FAIRBANKS
MODEL
CLASS
SERIAL
RATING
CAPACITY
S.W.M./C.O.C
TEMP
MAX
MIN


JAGUAR
G NET PT lb kg →0← ~
METTLER TOLEDO
ABC 7
DEF 8
GHI 9
ESC
JKL 4
MNO 5
PQR 6
→T←
STU 1
VWX 2
YZ? 3
$#% 0
-/= .
SP
→0←
DICKEY SCALES
Device # 41,616


OVERLOADS
ALLOWED
84500


10000


13766
FAIRBANKS
St. Johnsbury, VT
MOD
LCF-R3888-10
CAP
750 LBS @3.171 mV/V
S/N
736764

B-Tek Scale


2009/09/07


20/60/2002


2009/09/07

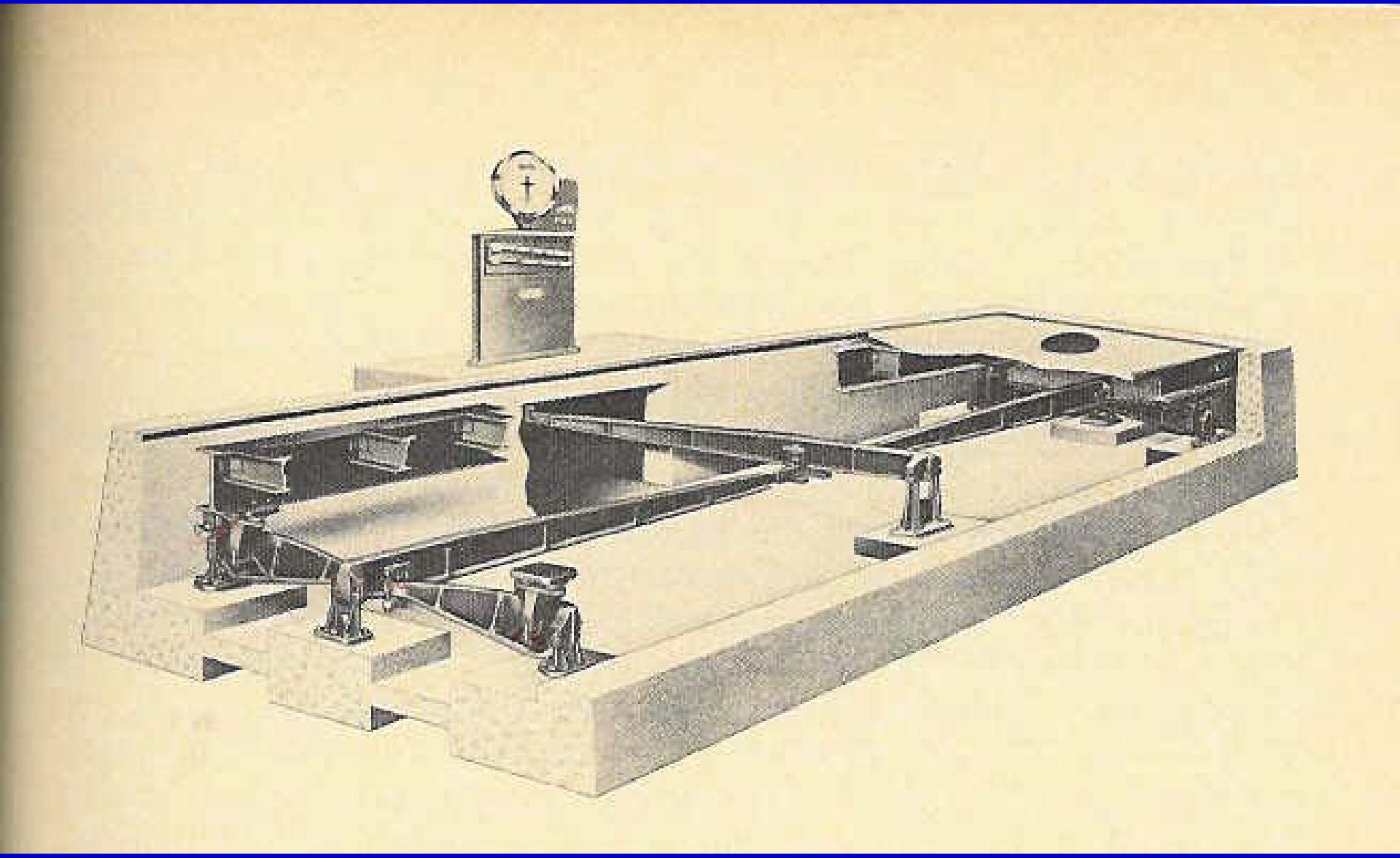
Scale Sections

Definition

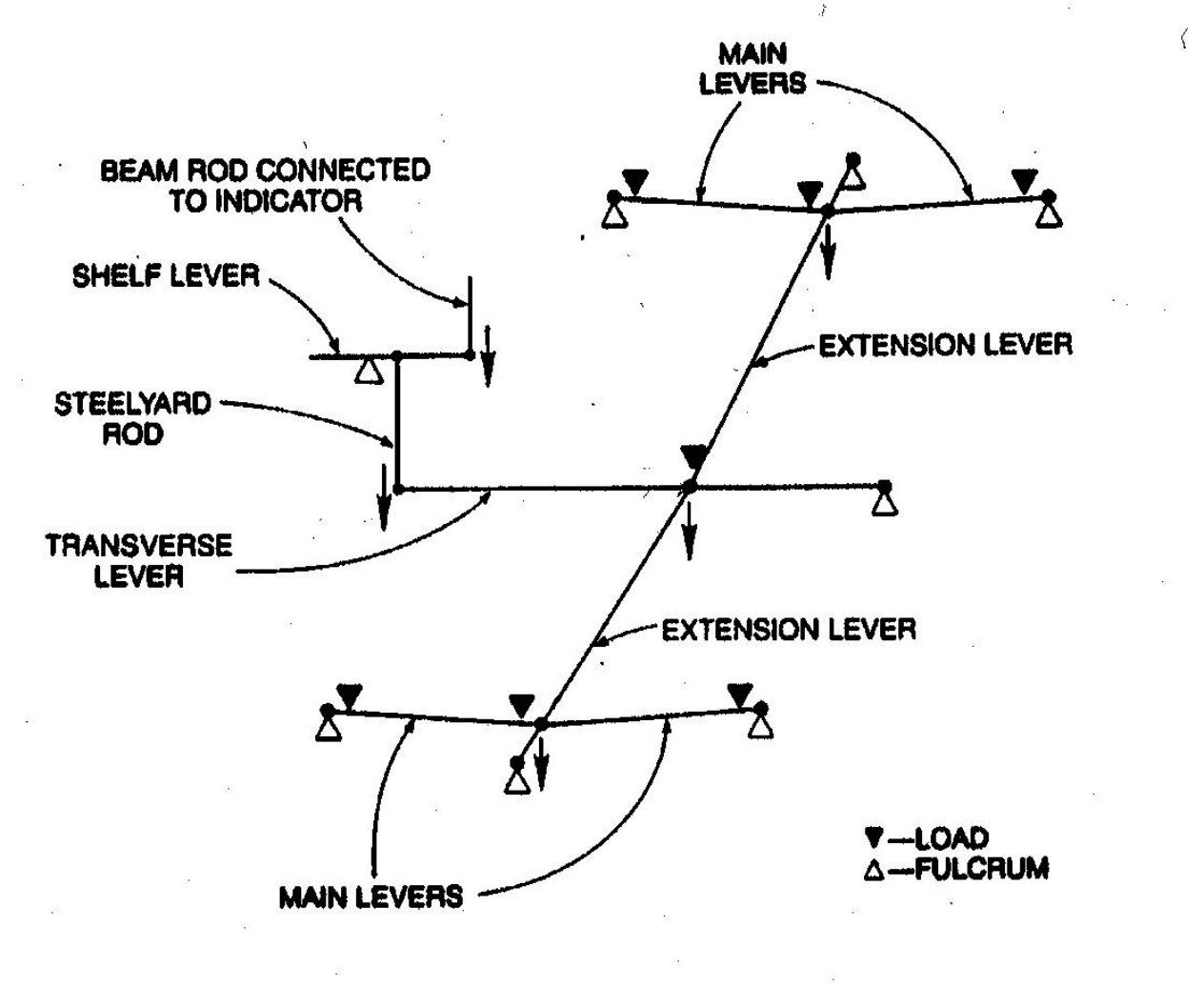
- Scale section. A part of a vehicle, axle load, livestock, or railway track scale consisting of two main load supports, usually transverse to the direction in which the load is applied.

Section Test

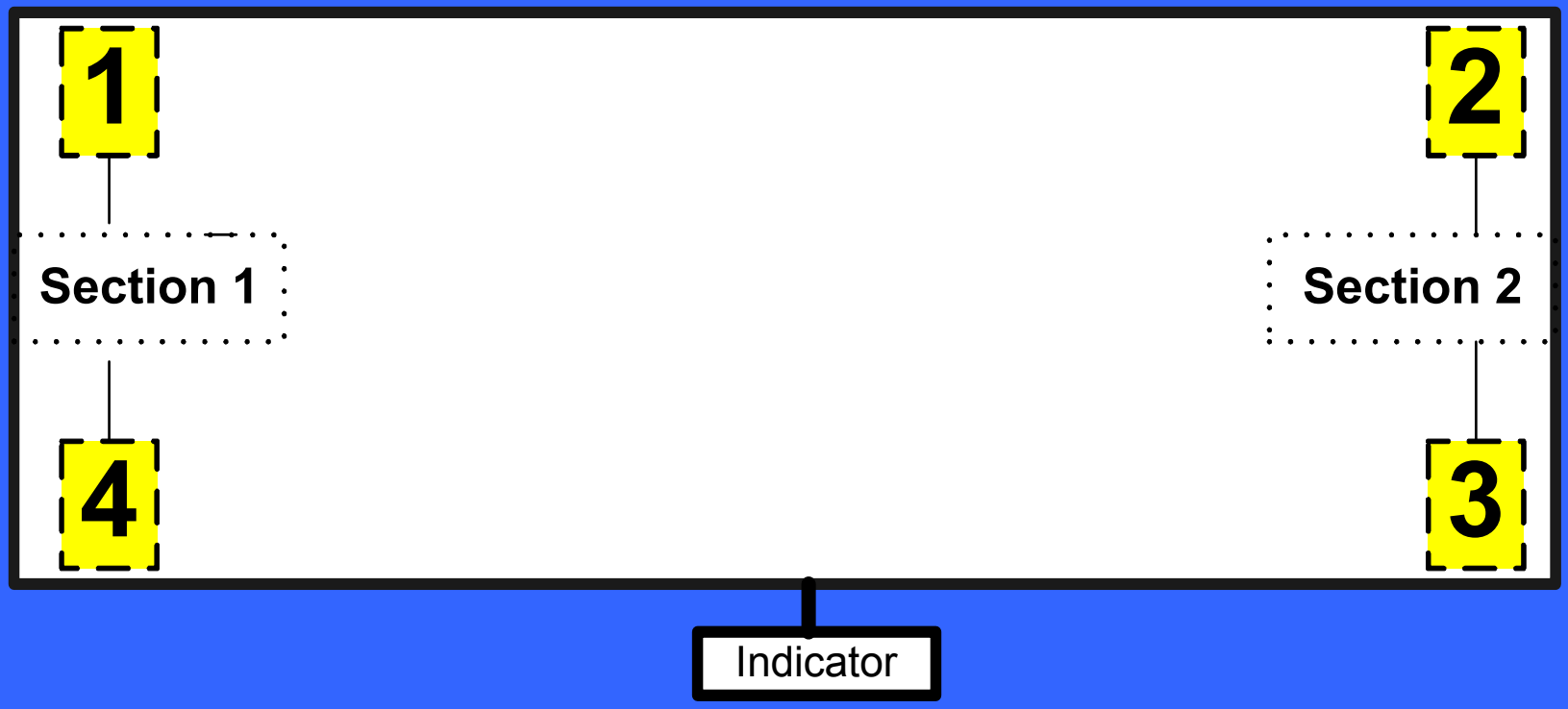
- A shift test in which the test load is applied over individual sections of the scale. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports.

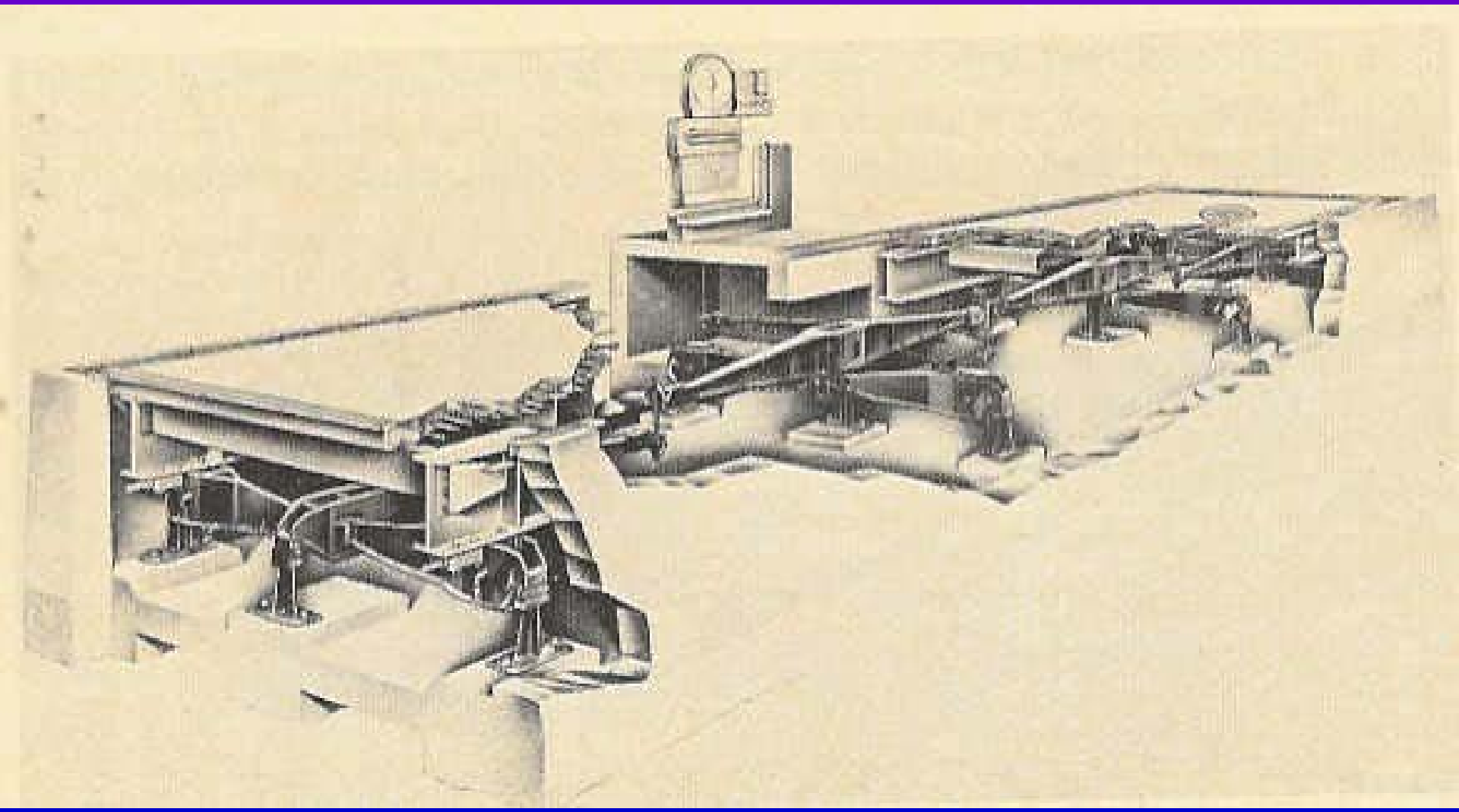


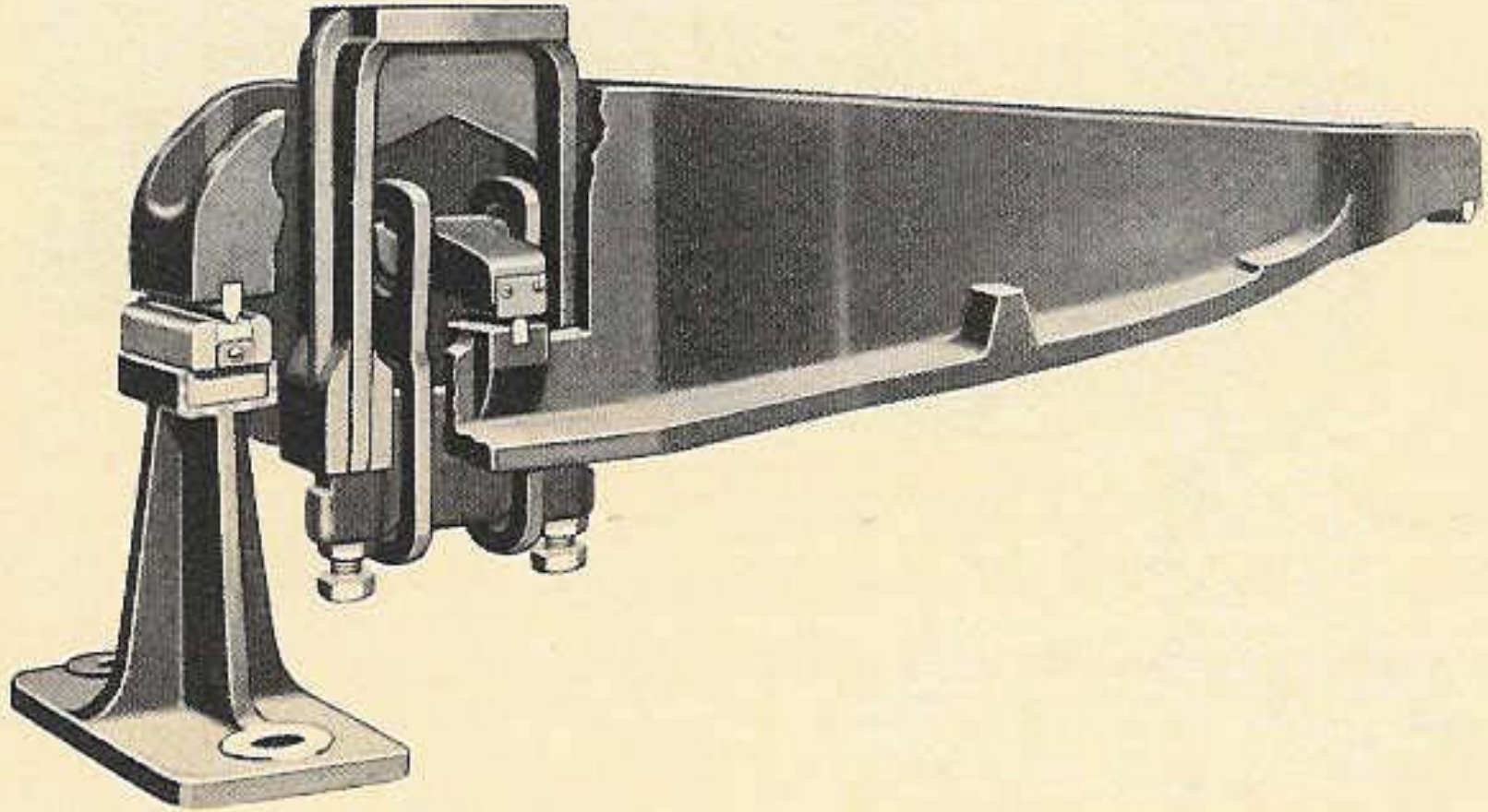
Two Section Scale

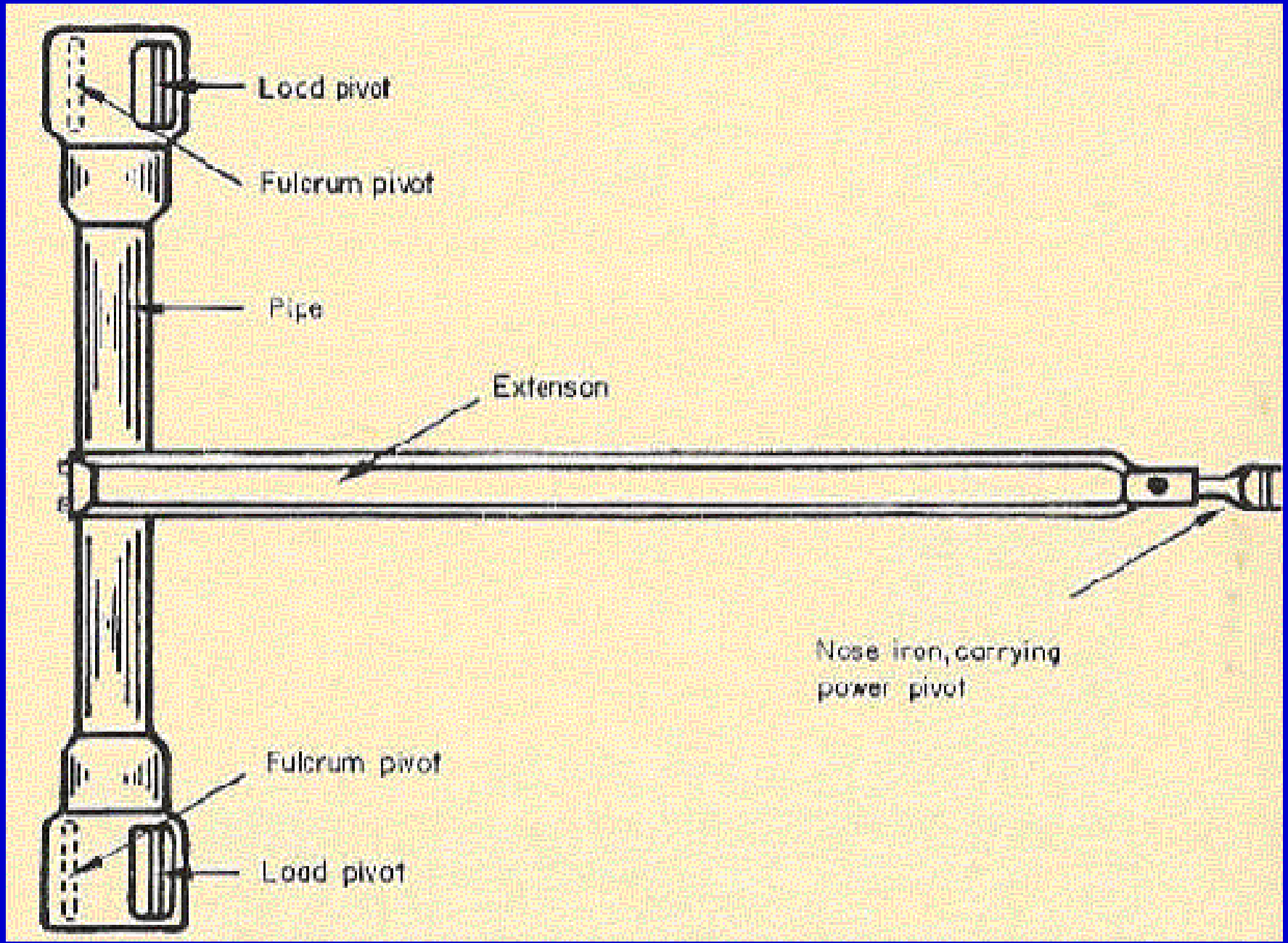


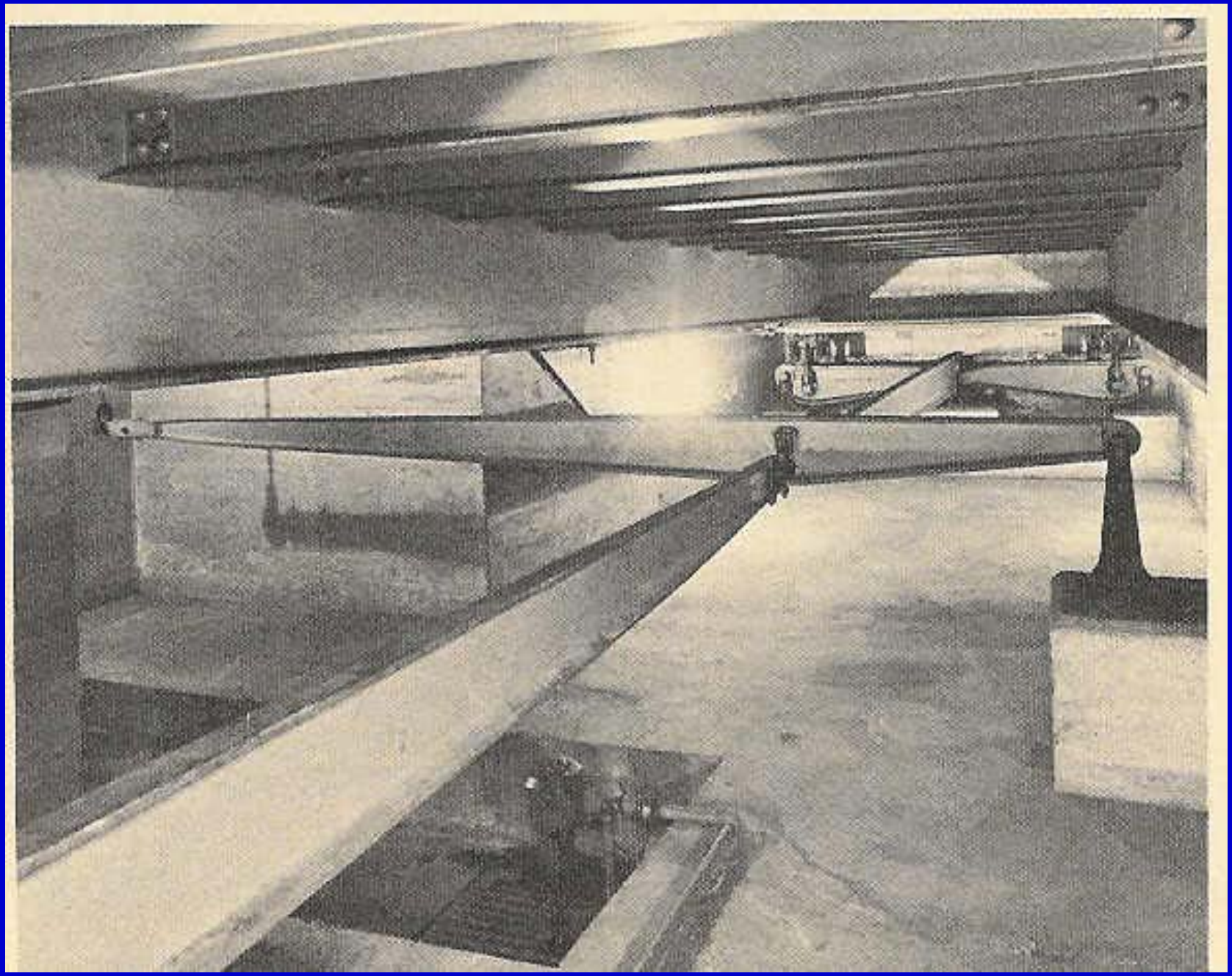
Each section is symmetrically the same.


1
2
Section 1
Section 2
4
3
Indicator






Load pivot
Fulcrum pivot
Pipe
Extension
Nose iron, carrying
power pivot
Fulcrum pivot
Load pivot



How do scales typically operate?

Weighing Elements

- Mechanical
- Electronic or Hydraulic Load Cells
- Electromechanical

Mechanical Weighing Elements Function of the Levers

- Reduce the force from the load **by a precise factor** and deliver that force to the indicating element.
- Support the force of the load

Points of Pressure on a Lever

- Power Pivot
- Load Pivot
- Fulcrum Pivot

Scale Levers

- 1. Direct comparison of forces
- 2. Extend the point of application
- 3. Alter the amount of force
- 4. Change the direction of a force

Lever Arms

- Load Arm – distance from the load to the fulcrum pivot
- Power Arm – distance from the power to the fulcrum pivot

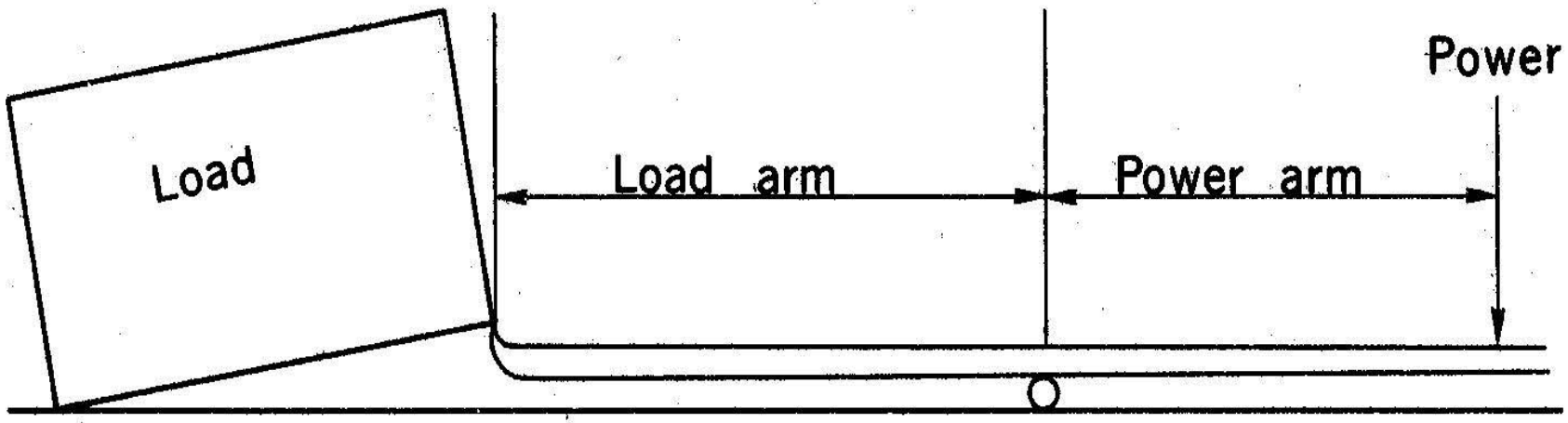


Figure 1.1. First Class Even Lever

Calculating the Multiple

- ? Ratio

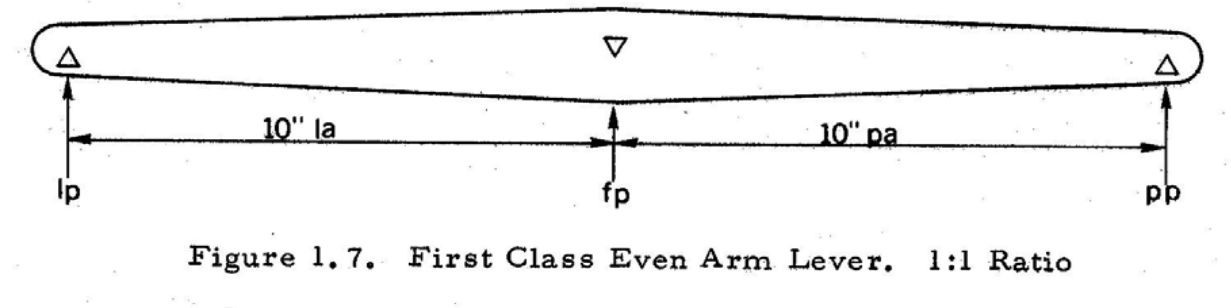


Figure 1.7. First Class Even Arm Lever. 1:1 Ratio

- ? Ratio

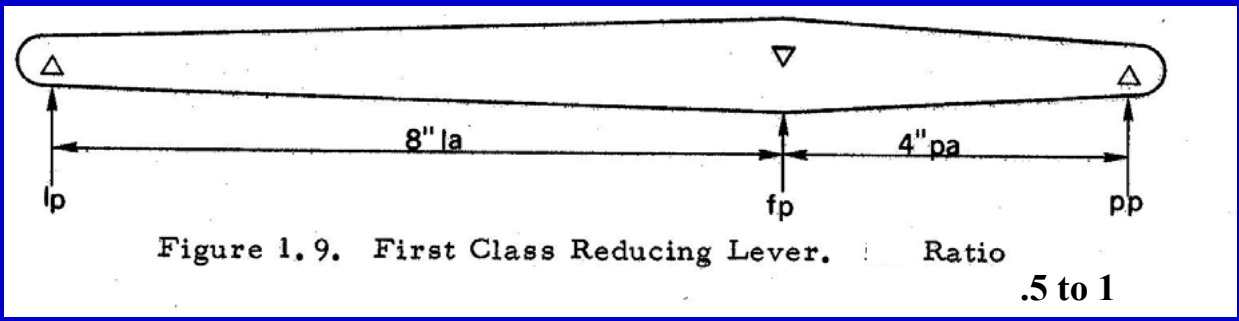


Figure 1.9. First Class Reducing Lever. Ratio .5 to 1

- ? Ratio

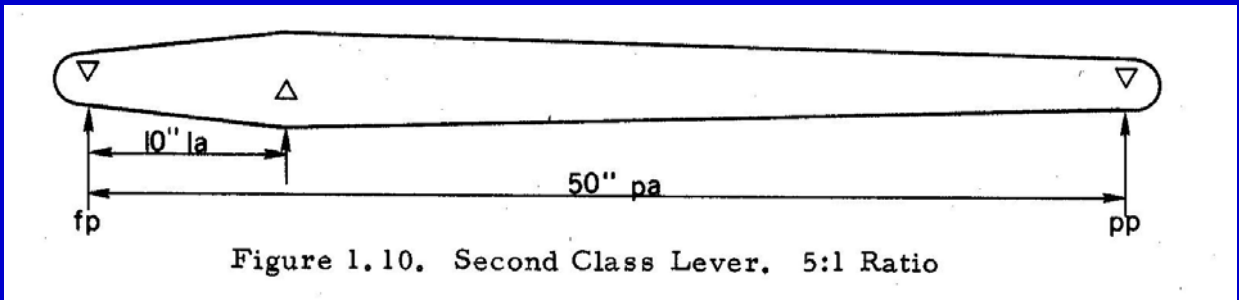


Figure 1.10. Second Class Lever. 5:1 Ratio

The Arms Are Used to Calculate the Multiple of the Lever

Power arm (pa) divided by load arm(la) equals multiple or ratio

First Class Lever

- A first class lever always has its fulcrum pivot between the load and the power pivots.
- The power and load arms extend to the left and to the right of the fulcrum.

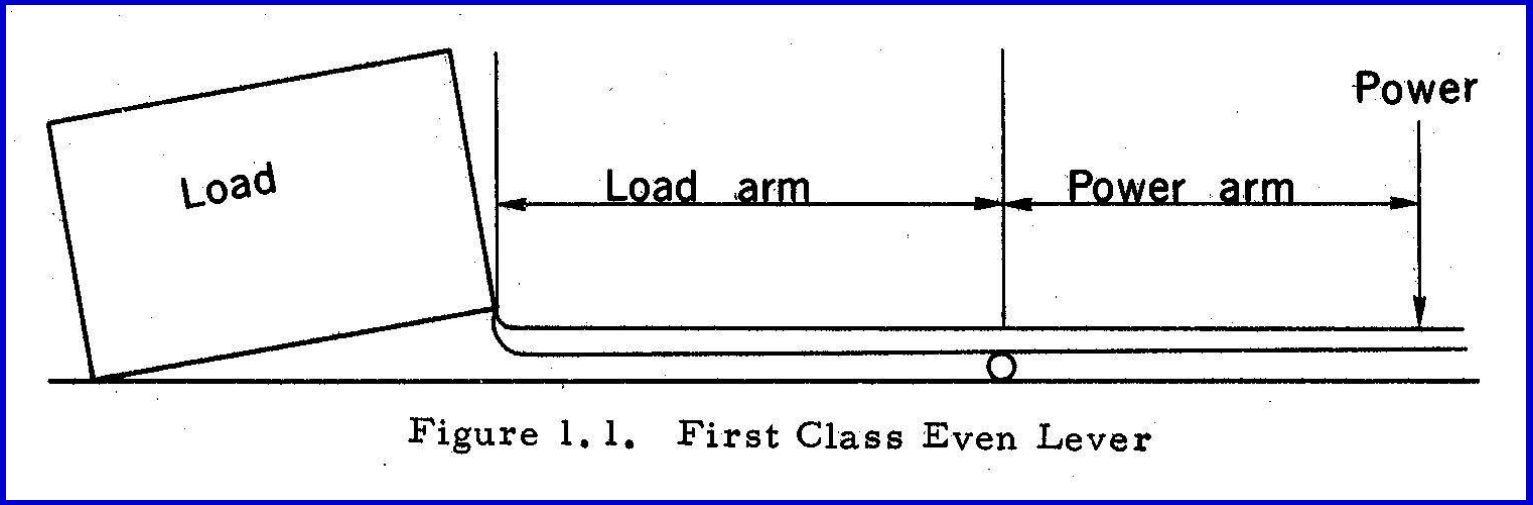


Figure 1.1. First Class Even Lever

Second Class Lever

- A second class lever will have the fulcrum pivot located at one end and the load arm is always contained in the power arm.

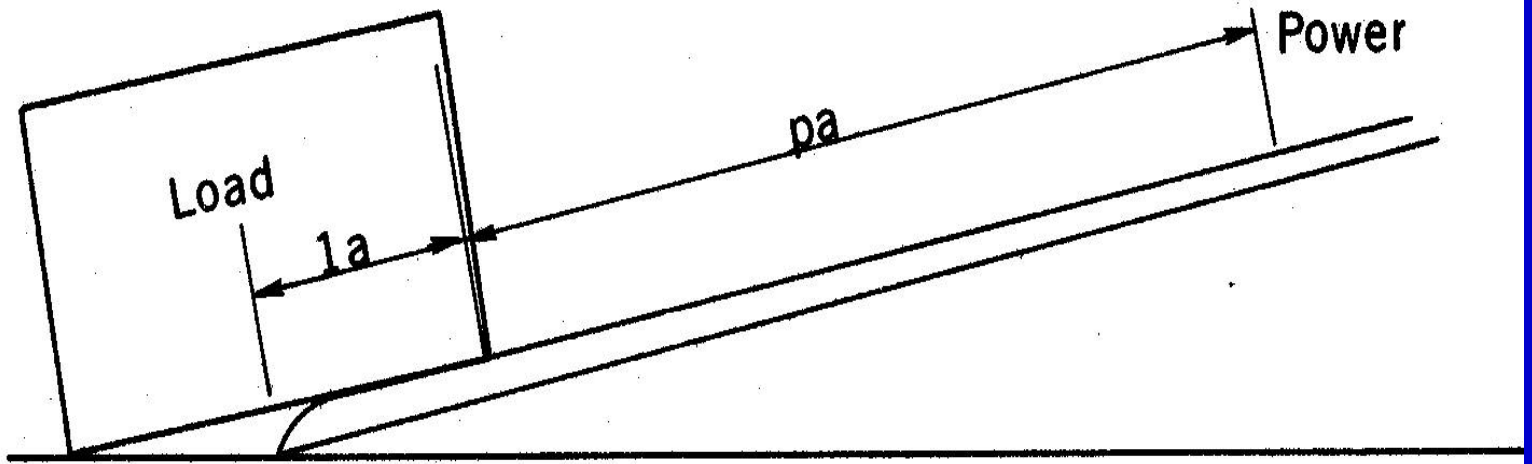


Figure 1.5. Second Class Multiplying Lever

Third Class Lever

- The fulcrum pivot of a third class lever is also located at one end, but in this case, it is the power arm that is contained in the load arm.

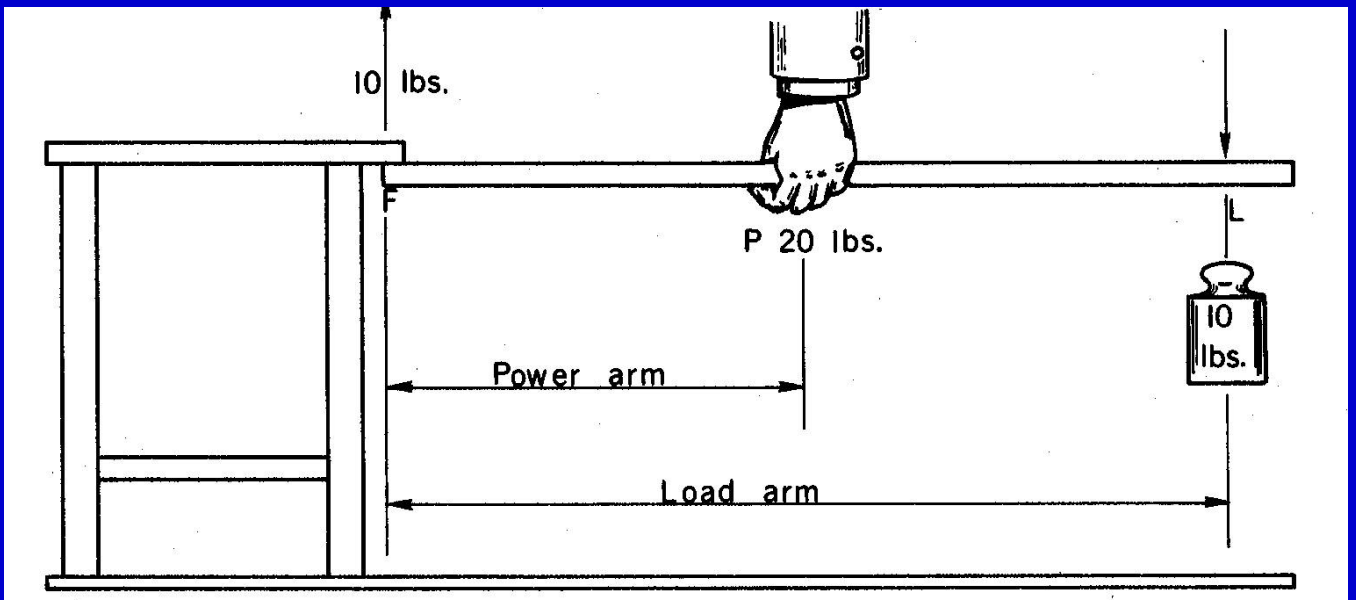


Figure 1.6. Third Class Lever

Vehicle and Axle-load Scales Utilize a Multiple Lever System to Reduce the Force of the Load and Deliver it to the Indicating Element.

Diagram of a 4 Section Vehicle Scale

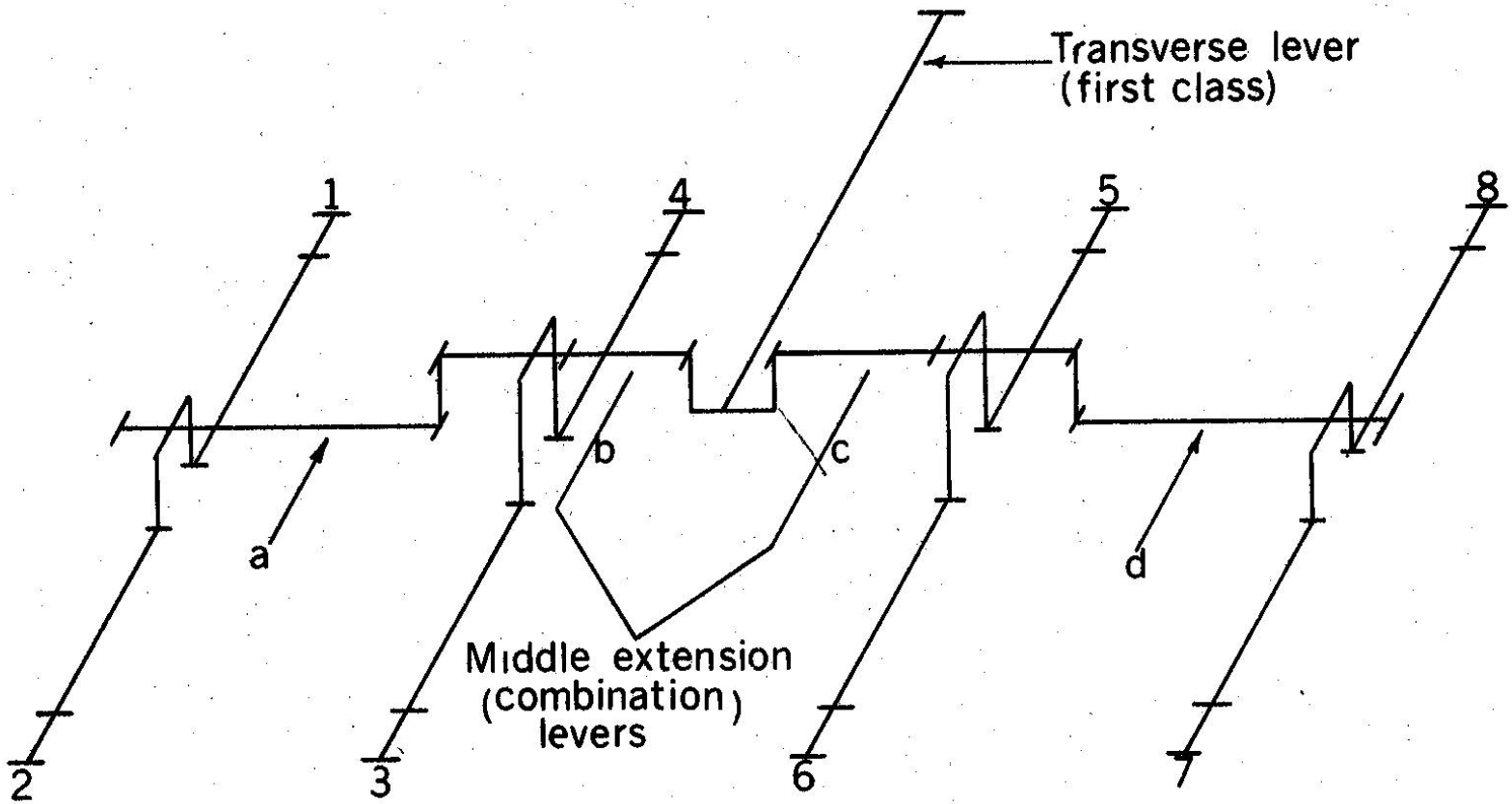


Figure 1.2.25. Four Section Straight Lever

The Total Multiple of a Lever System Is the Final Multiple of All the Levers Coupled in Series

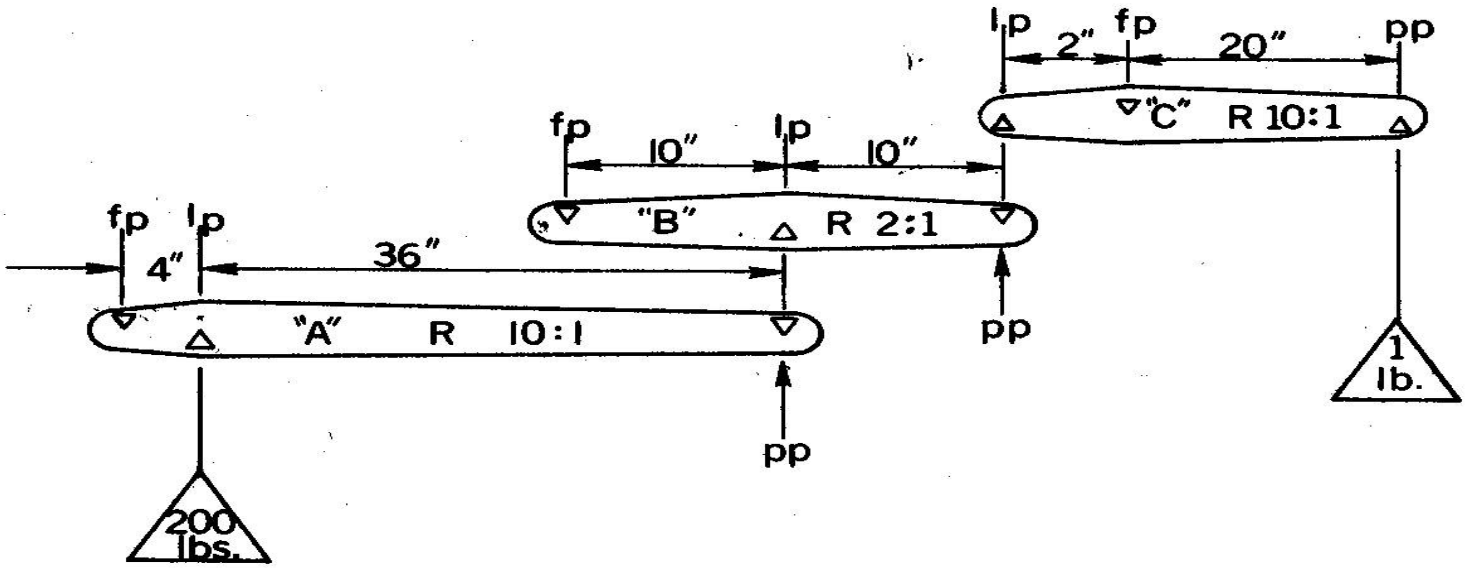


Figure 1.18. Multiple Lever System

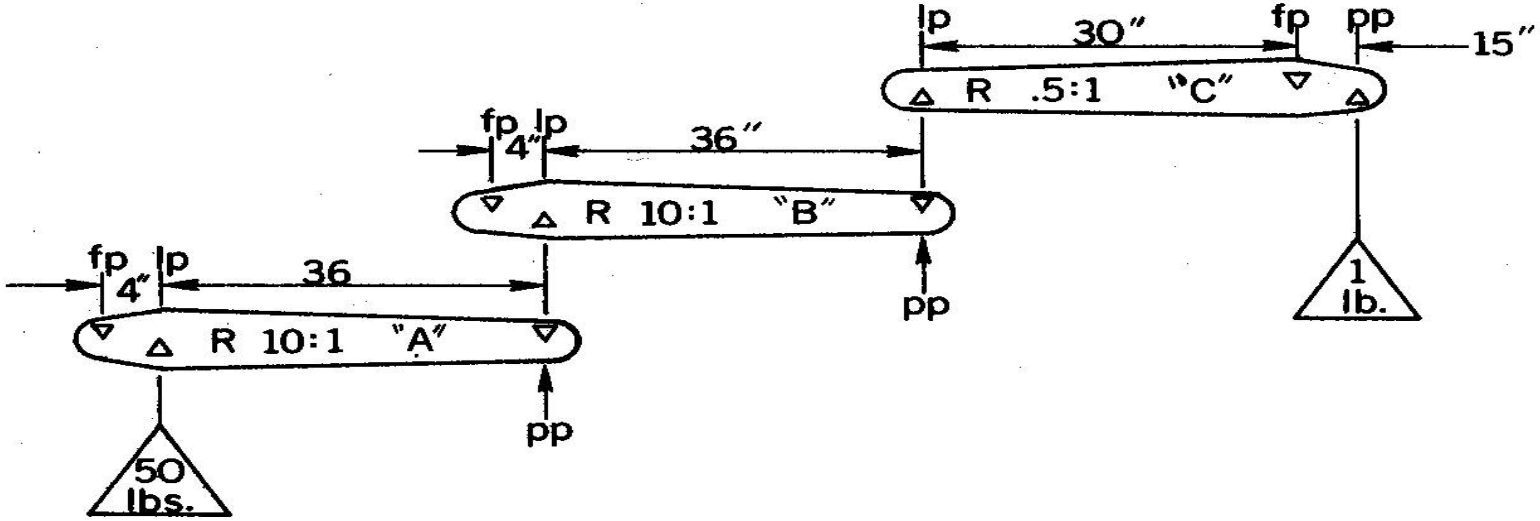


Figure 1.19. Multiple Lever System (Train)

What Happens when the Surface Edge of a Pivot Is Changed?

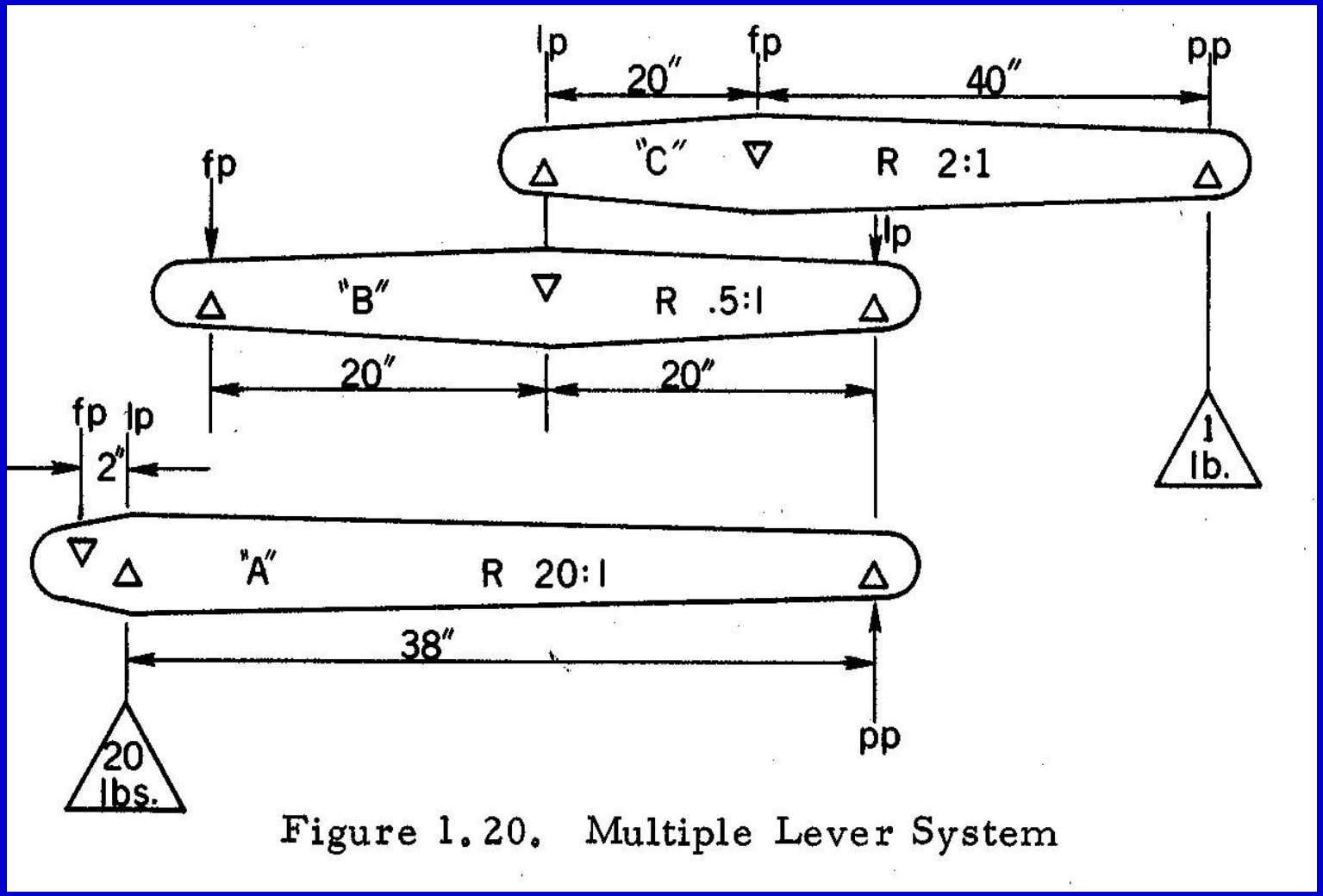


Figure 1.20. Multiple Lever System

How a load is distributed and weighed on vehicle and axle-load scales.

End View of Lever System

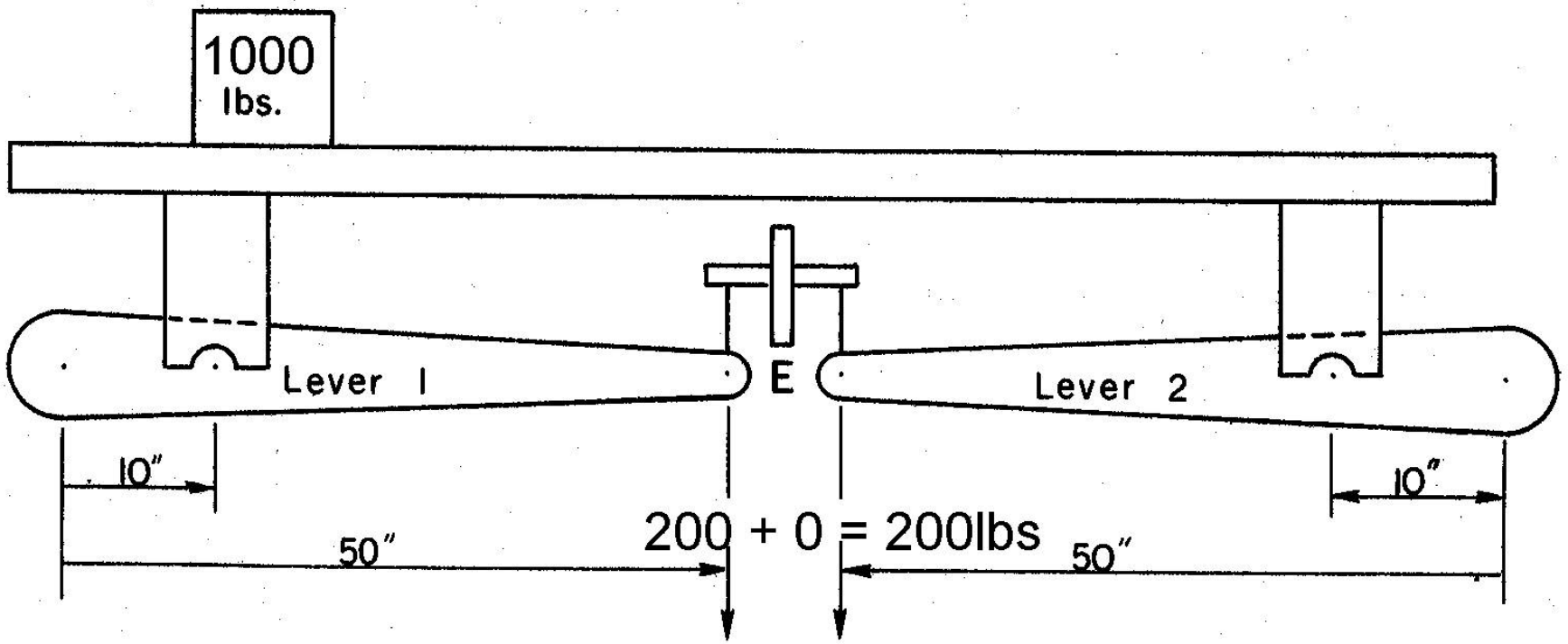
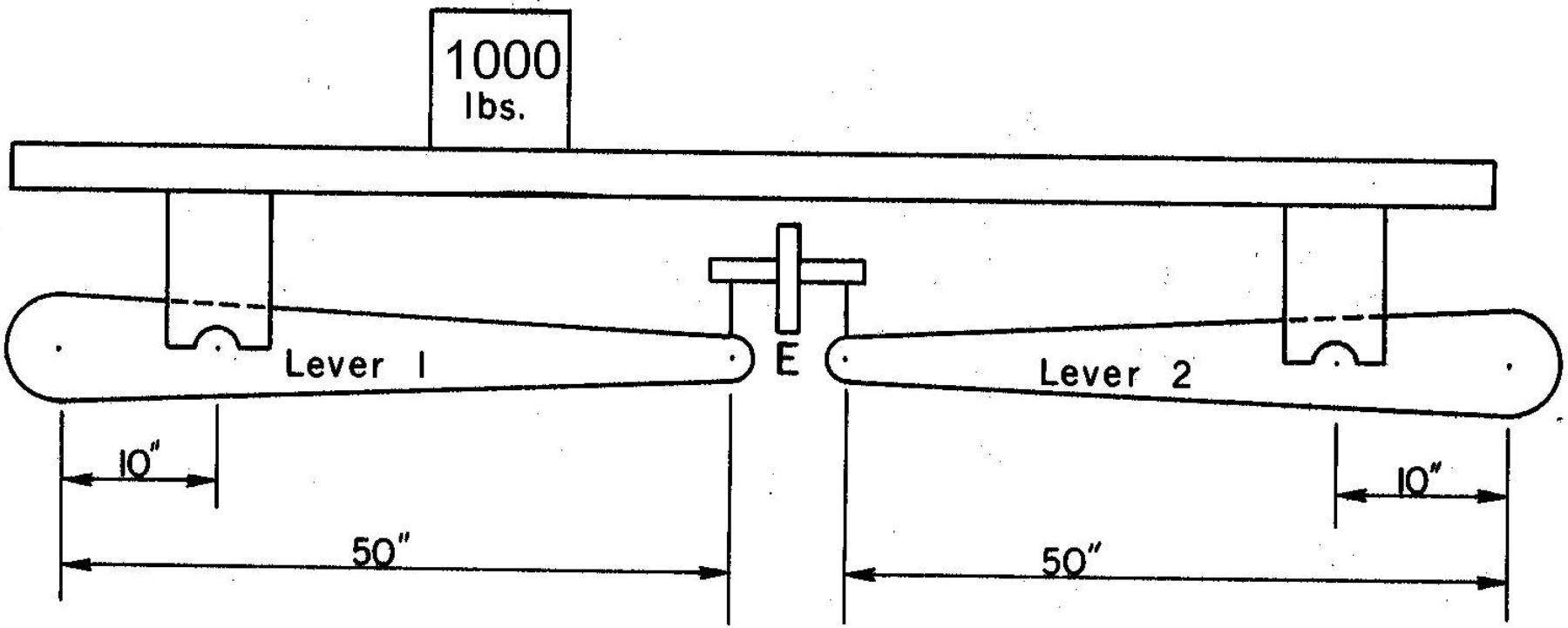


Figure 1.22. Parallel Lever



150 + 50 = 200 lbs

Figure 1.21. Parallel Lever

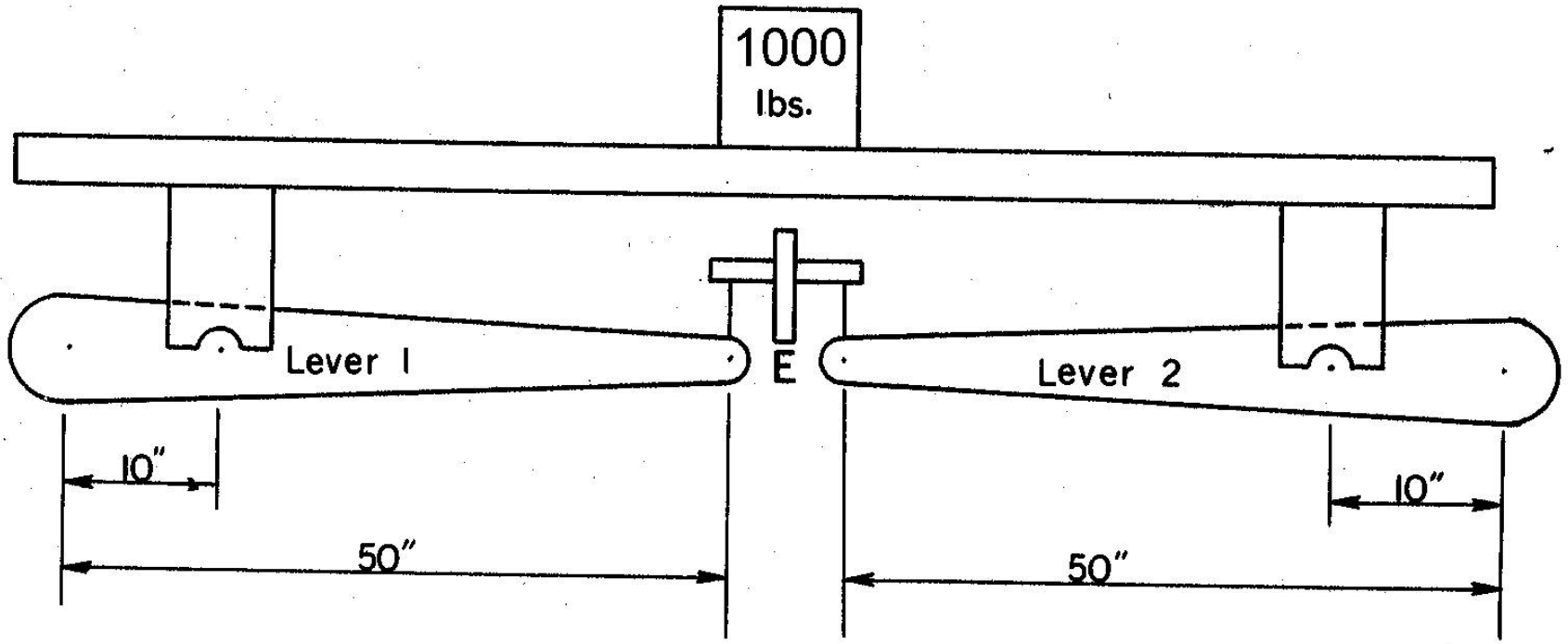
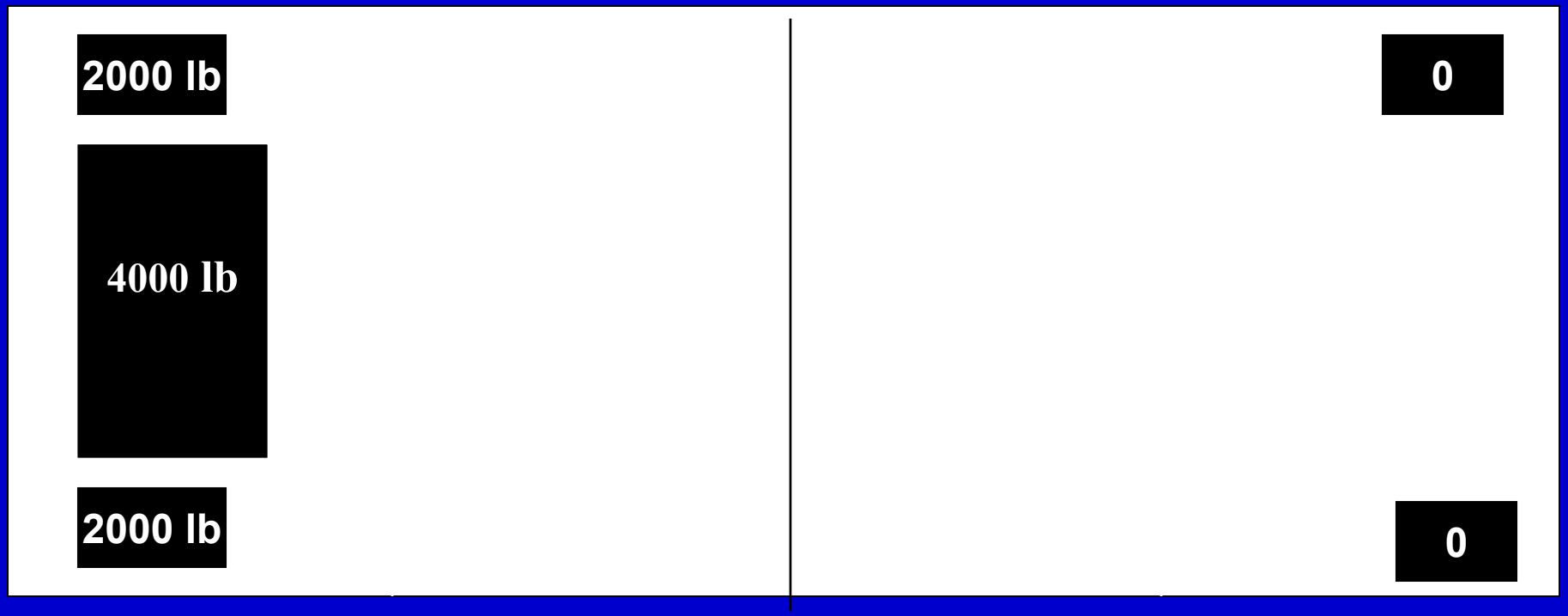
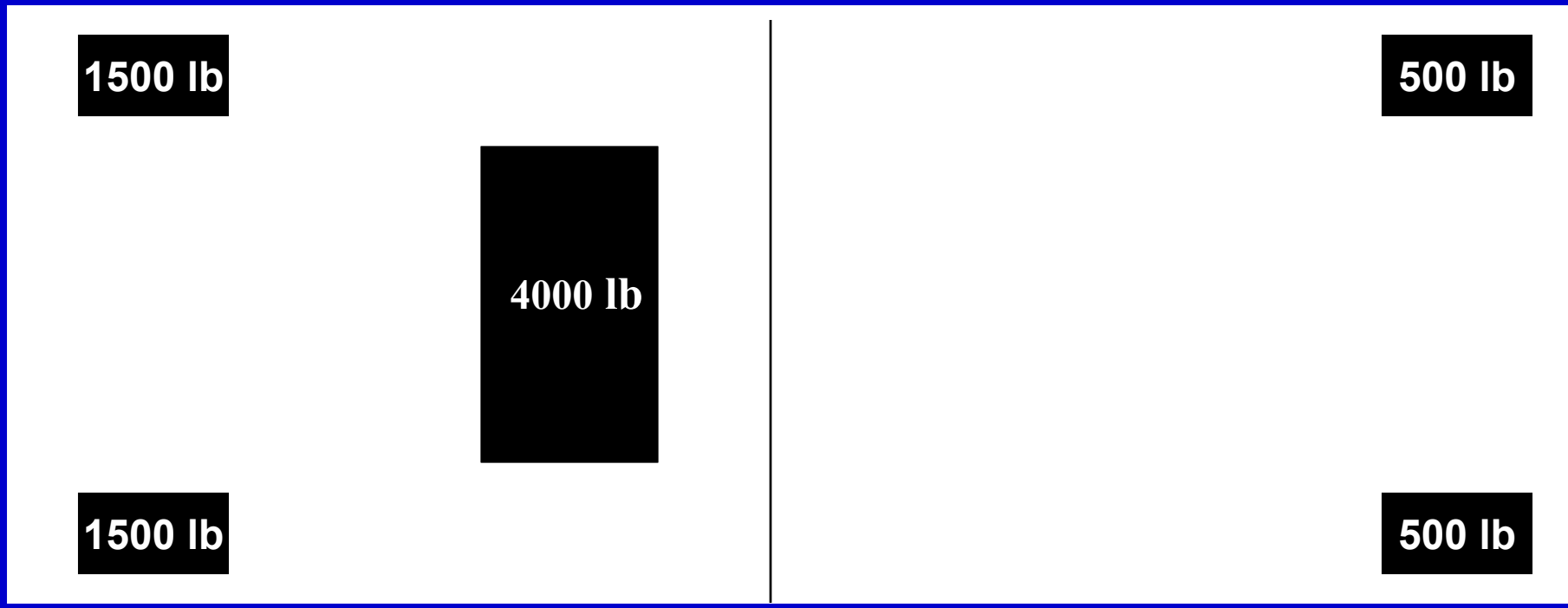
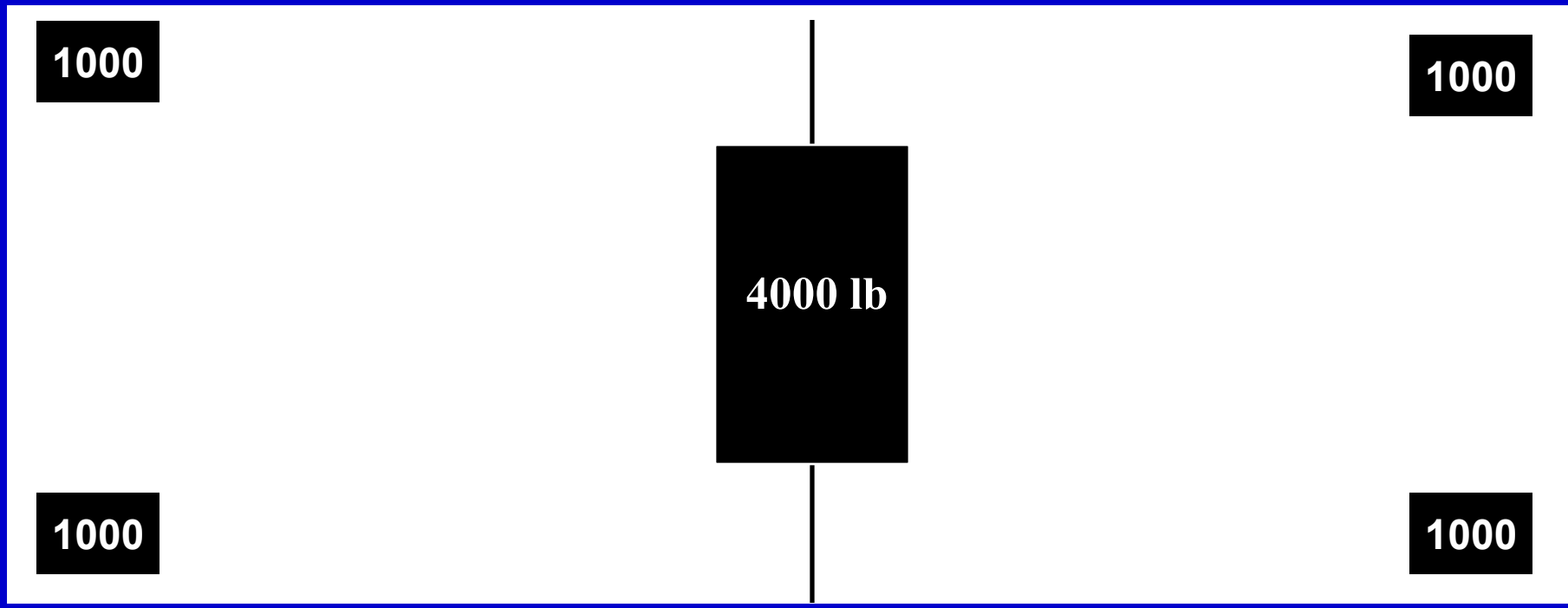


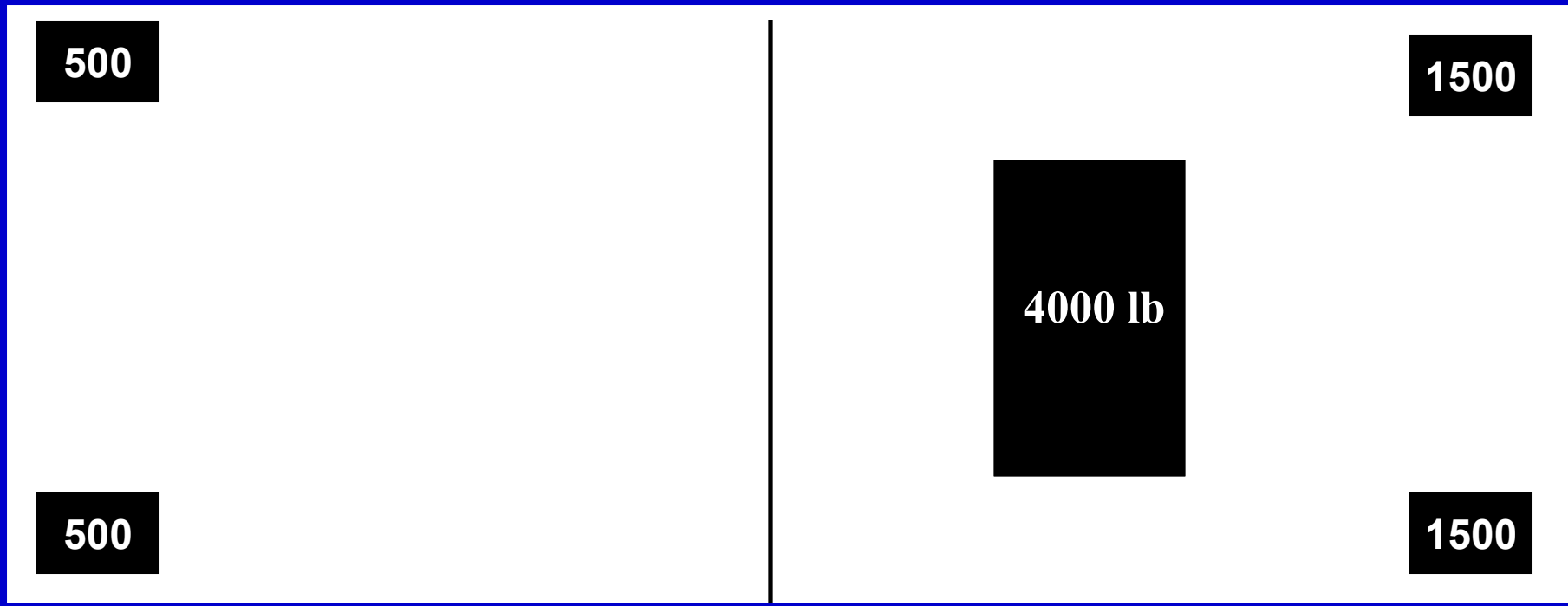
Figure 1.23. Parallel Lever

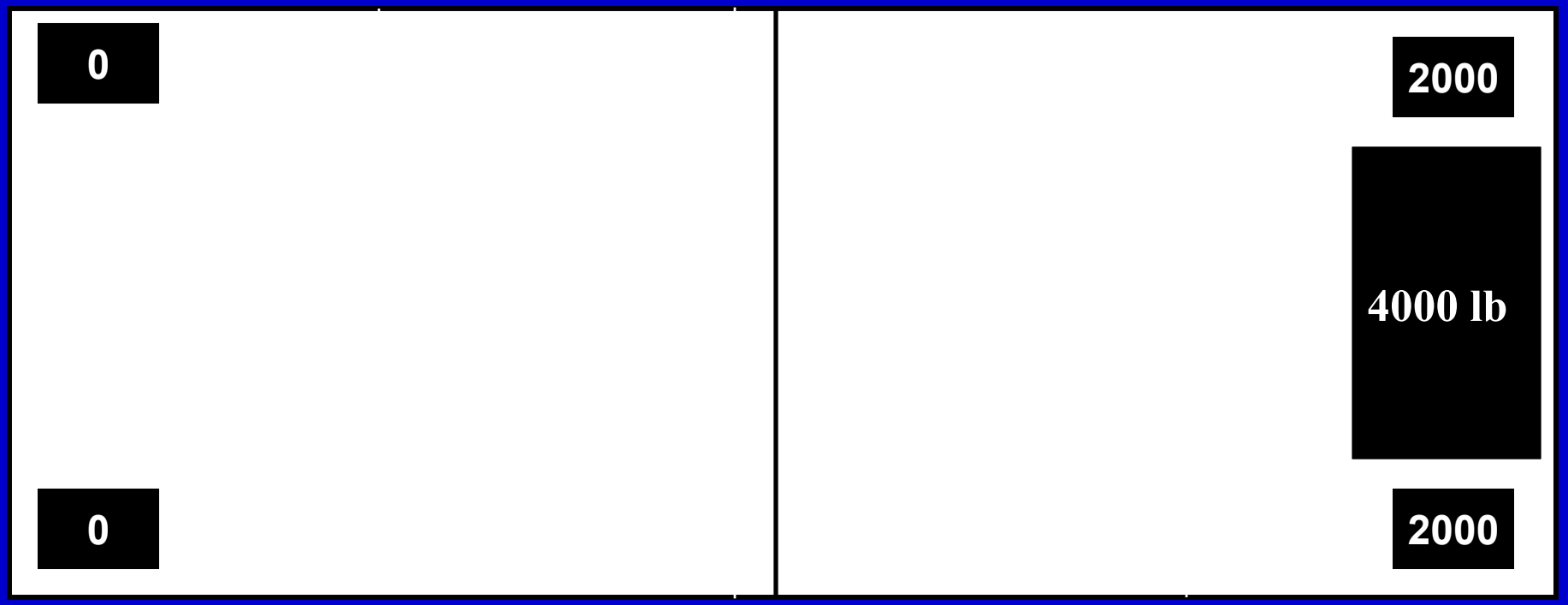
Summing the Weight of the Load




1500 lb
4000 lb
1500 lb
500 lb
500 lb


1000
1000
4000 lb
1000
1000


500
1500
4000 lb
500
1500


0
2000
4000 lb
0
2000

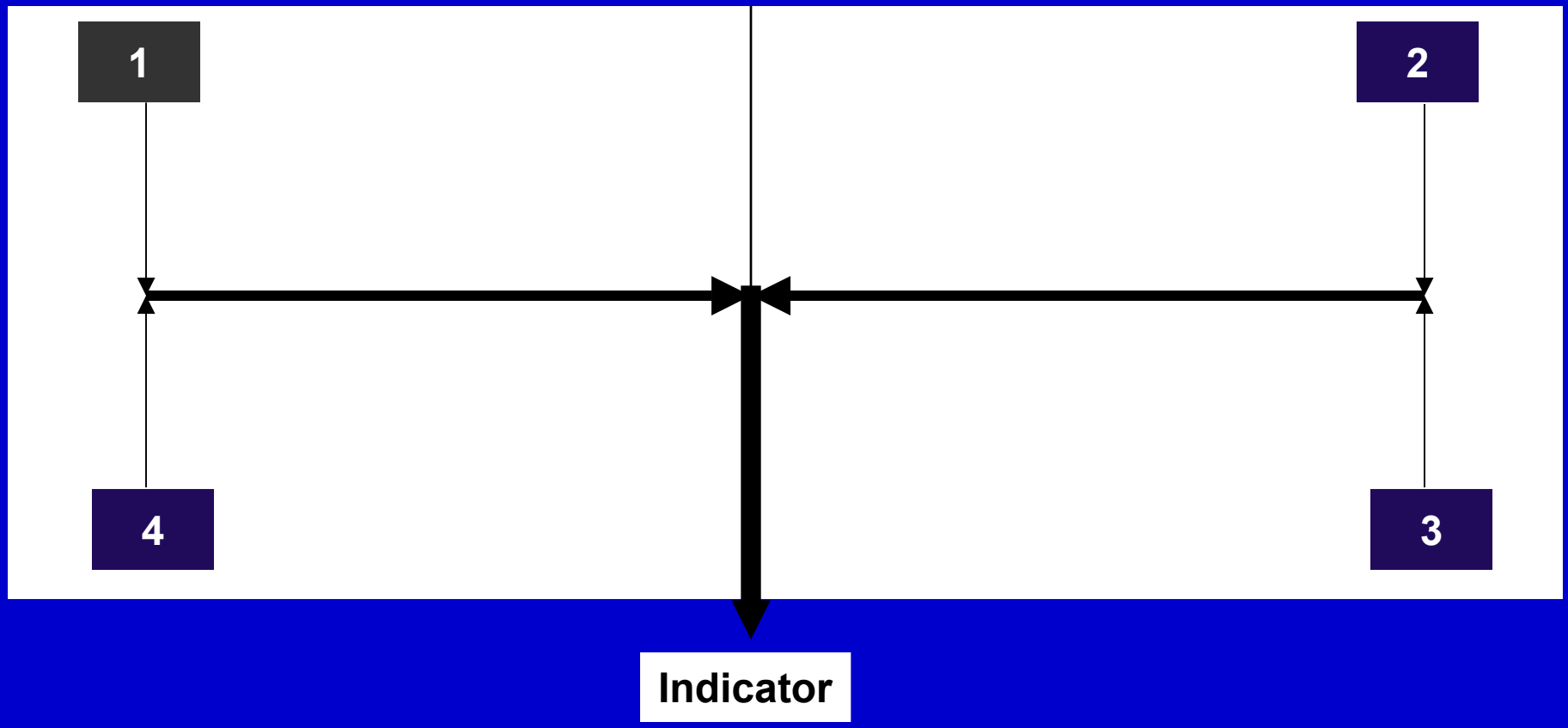
How are Mechanical Scales Calibrated?

- Individual sections are adjusted.
- End and other sections are adjustable in pairs.
- Once sections are in agreement a nose iron adjustment at the transverse lever will adjust overall scale indication.

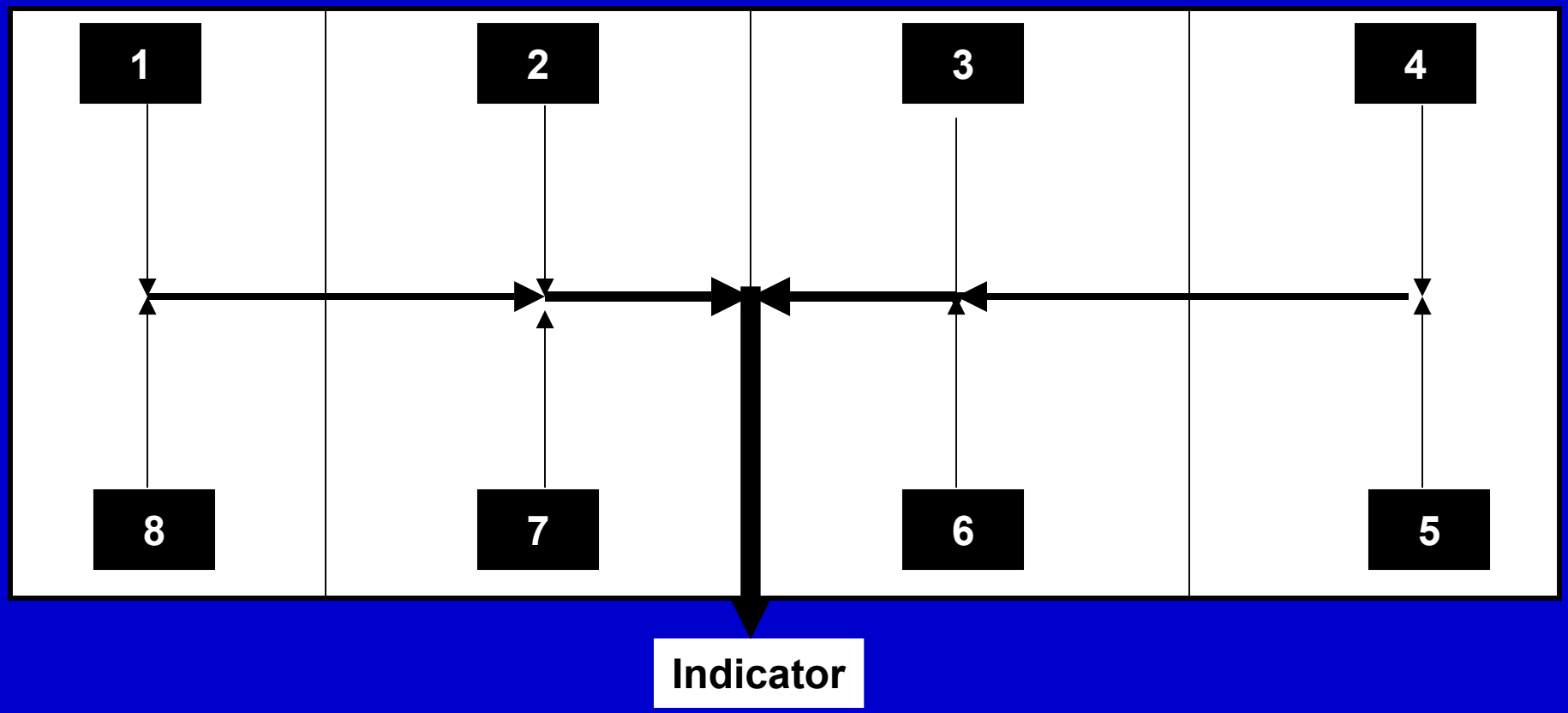
How are Electronic Scales Calibrated?

- Individual load cells & sections are adjusted.
- Scale span is adjusted.

Adjusting a Two Section Scale



Adjusting a Four Section Scale



Summary

- Definition of commercial and law enforcement equipment
- Applications for vehicle scales
- Components
  - Indicators
  - Load Receiving and Weighing Elements
- Sections and Shift Test
- Operation and calibration of scales.